MRI COLONOGRAPHY VERSUS CONVENTIONAL COLONOSCOPY IN DETECTION OF COLONIC POLYPOSIS

Dissertation Submitted in partial fulfillment of

M.D. DEGREE EXAMINATION

M.D. RADIODIAGNOSIS- BRANCH VIII

MADRAS MEDICAL COLLEGE

CHENNAI.

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMILNADU- INDIA

MARCH 2010

CERTIFICATE

This is to certify that **DR. P. Kumar** has been a post graduate student during the period May 2007 to March 2010 at Department of Radiodiagnosis, Madras Medical College and Research Institute, Government General Hospital, Chennai.

This Dissertation titled **"MRI Colonography Versus Conventional Colonoscopy In Detection Of Colonic Polyposis"** is a bonafide work done by him during the study period and is being submitted to the Tamilnadu Dr. M.G. R. Medical University in Partial fulfillment of the Branch VIII- M.D. RadioDiagnosis Examination.

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ACKNOWLEDGEMENT

I express my profound gratitude to **Dr. P.MOHANASUNDARAM, M.D**., PhD, Dean Madras Medical College, Government General Hospital, Chennai who with his vast knowledge and experience has been a great source of inspiration. I am grateful to him for permitting me to utilize the facilities of this institution for conducting this study.

I express my heartfelt gratitude to **Prof. M. PRABAKARAN MD, DMRD, Director, Barnard Institute of Radiology**, for having formulated the study, for the able guidance throughout the work and the prompt help rendered whenever approached.

I profoundly thank **Prof. T. S. SWAMINATHAN M.D, DMRD, FICR., Former Director of Barnard Institute of Radiology,** for his continuous encouragement, help and guidance, without whose co-operation my clinical work would not have been completed.

I profoundly thank **Prof. N. KAILASANATHAN MD., DMRD. Prof.K.Malathy MD., DMRD., Barnard Institute of Radiology** for continuous guidance and support in completing the thesis work.

I wish to express my gratitude to all the Assistant Professors in our Department **DR. S. SUNDARESWARAN, DR. NESAM MANIVANNAN, DR.S.KALPANA, DR.S.BABUPETER, DR.D.RAMESH, DR.C.AMARNATH** and

DR.J.DEVIMEENAL who helped me with their timely advice during the study.

I am indebted to the Radiation Physicist of our Department **Prof. K. THAYALAN** for giving me their time and help.

I wish to express my gratitude to **Prof.K.VANITHA**, MD,DMRD,DRM Chennai, for her consistent support and guidance.

I wish to thank all my Post Graduate colleagues who co-operated with me and helped me during this study.

I wish to thank our Department MRI Technicians for their kind co-operation during the study.

Last but not least, I wish to thank all the patients without whose kind co-operation, this study would not have been possible.

CONTENTS

INTRODUCTION

In the mid-1970s, approximately 60 cases of colorectal cancer were diagnosed per 100,000 people in the United States, and approximately 51% of those diagnosed survived their disease at least five years. Over the last two decades, incidence rates have fallen by nearly 26% between 1984 and 2004. This decline is likely due to increased colorectal cancer screening, which allows physicians to detect and remove colorectal polyps before they progress to cancer. Yet, incidence is still high: colorectal cancer is the third most commonly diagnosed cancer for both men and women. As of 2004, approximately 48 cases of colorectal cancer were diagnosed per 100,000 people in the United States. About 65% of men and women diagnosed with colorectal cancer now survive their disease at least five years.[1]

DEFINITION OF POLYP

A polyp is defined as a fibro vascular structure arising from the mucosa and protruding into the lumen of a hollow organ with or without a pedicle.

ETIOLOGY

An assessment of causative factors have shown that

- Hyperplastic

  - minimal cancer potential
    - Adenomatous
  - approximately 90% of colon and rectal cancers arise from adenomas

Benefits of Screening

- Cancer Prevention
  - Removal of pre-cancerous polyps prevent cancer (unique aspect of colon cancer screening)
- Improved survival
  - Early detection markedly improves chances of long term survival

Currently available procedures each with its drawbacks include Barium enema, which is highly subjective and expose patient to ionizing Radiation. Conventional colonoscopy: which is invasive and, CT Colonography, which expose patient to ionizing radiation and contrast medium. Of the three techniques conventional colonoscopy has been commonly used.[2]

In recent years major technologic advances in diagnostic MRI have led to improve image quality particularly with the use of Fast sequence

and surface coil. Positive contrast like water/saline can be used to distend the colonic lumen[3].

This study undertaken in the Barnard Institute of Radiology gives our experience in MR Colonography in 35 cases of suspected colonic polyps.

AIM OF THE STUDY

1) To evaluate the specificity of employing MRI Colonography as a minimally invasive screening test in assessment of colonic polyps.

2) To compare accuracy, positive predictive value and efficacy of MRI Colonography with that of conventional colonoscopy in assessment of colonic polyps.

ANATOMY AND PHYSIOLOGY OF COLON

GROSS ANATOMY

The large bowel comprises the colon, rectum and anus(Fig-1). Its length is about 100 cm.The ascending and descending colon and rectum are retroperitoneal. The transverse and sigmoid colon have a mesentery formed from a double layer of visceral peritoneum sandwiching connective and adipose tissue with vessels, nerves and lymphatics. The caecum, hepatic and splenic flexures may also have short mesenteries.

The caecum is the first part of the large intestine that is continuous with the ascending colon. It is a blind intestinal pouch, approximately 7.5 cm in both length and breadth, located in the right lower quadrant, where it lies in the iliac fossa inferior to the junction of the terminal ileum and caecum. The caecum usually lies within 2.5 cm of the inguinal ligament, is almost entirely enveloped by peritoneum. However, the caecum has no mesentery. Because of its relative freedom, it may be displaced from the iliac fossa, but it is commonly bound to the lateral abdominal wall by one or more caecal folds of peritoneum . The terminal ileum enters the caecum obliquely and partly invaginates into it.The caecum is supplied by the ileocolic artery, the terminal branch of the SMA. A tributary of the SMV, the ileocolic vein, drains blood from the caecum.The lymphatic

vessels from the caecum and appendix pass to lymph nodes in the mesoappendix and to the ileocolic lymph nodes that lie along the ileocolic artery.

The ascending colon is the second part of the large intestine. It passes superiorly on the right side of the abdominal cavity from the caecum to the right lobe of the liver, where it turns to the left at the right colic flexure (hepatic flexure).The ascending colon is narrower than the caecum and is secondarily retroperitoneal along the right side of the posterior abdominal wall. The ascending colon is covered by peritoneum anteriorly and on its sides; however, in approximately 25% of people it has a short mesentery. The ascending colon is separated from the anterolateral abdominal wall by the greater omentum. A deep vertical groove lined with parietal peritoneum, the right paracolic gutter, lies between the lateral aspect of the ascending colon and the adjacent abdominal wall .The arterial supply to the ascending colon and right colic flexure is from branches of the SMA, the ileocolic and right col ic arteries. Tributaries of the SMV, the ileocolic and right colic veins, drain blood from the ascending colon. The lymphatic vessels pass first to the epicolic and paracolic lymph nodes, next to the ileocolic and intermediate right colic lymph nodes, and from them to the superior mesenteric lymph nodes.

The transverse colon (approximately 45 cm long) is the third, longest, and most mobile part of the large intestine. It crosses the

abdomen from the right colic flexure to the left colic flexure, where it bends inferiorly to become the descending colon. The left colic flexure (splenic flexure) is usually more superior, more acute, and less mobile than the right colic flexure. Being freely movable, the transverse colon is variable in position, usually hanging to the level of the umbilicus (L3 vertebral level) . However, in tall thin people, the transverse colon may extend into the pelvis. The arterial supply of the transverse colon is mainly from the middle colic artery, a branch of the SMA. However, the transverse colon may also receive arterial blood from the right and left colic arteries via anastomoses, part of the series of anastomotic arcades that collectively form the marginal artery (juxtacolic artery). Venous drainage of the transverse colon is through the SMV. The lymphatic drainage of the transverse colon is to the middle colic lymph nodes, which in turn drain to the superior mesenteric lymph nodes.

The sigmoid colon, characterized by its S-shaped loop of variable length (usually approximately 40 cm), links the descending colon and the rectum. The sigmoid colon extends from the iliac fossa to the S3 segment, where it joins the rectum. The termination of the teniae coli, approximately 15 cm from the anus, indicates the rectosigmoid junction. The sigmoid colon usually has a long mesentery and, therefore, has considerable freedom of movement, especially its middle part. The arterial supply of the descending and sigmoid colon is from the left colic and sigmoid arteries, branches of the inferior mesenteric artery. The

lymphatic vessels from the descending colon and sigmoid colon pass to the epicolic and paracolic nodes and then through the intermediate colic lymph nodes along the left colic artery. Lymph from these nodes passes to the inferior mesenteric lymph nodes that lie around the inferior mesenteric artery. However, lymph from the left colic flexure may also drain to the superior mesenteric lymph nodes.

The rectum is the fixed (primarily retroperitoneal and subperitoneal) terminal part of the large intestine. It is continuous with the sigmoid colon at the level of S3 vertebra. The junction is at the inferior end of the mesentery of the sigmoid colon. The rectum is continuous inferiorly with the anal canal.

Nerve supply of colon

The left colic flexure also marks the divide between cranial (vagal) and sacral (pelvic splanchnic) parasympathetic innervations of the alimentary tract. Sympathetic fibers are conveyed to the large intestine via abdominopelvic (lesser and lumbar) splanchnic nerves via the prevertebral (superior and inferior mesenteric) ganglia and periarterial plexuses. The middle of the sigmoid colon marks a divide in the sensory innervation of the abdominal alimentary tract. orad, visceral afferents for pain travel retrogradely with sympathetic fibers to spinal sensory ganglia, whereas those conveying reflex information travel with parasympathetic

fibers to vagal sensory ganglia. Aborad, both types of visceral afferent fibers travel with parasympathetic fibers to spinal sensory ganglia.

HISTOLOGY

4 layers

1. **Mucosa-** is columnar in type with goblet and some enterochromaffin cells arranged in crypts (of Lieberkühn). The surface pattern consists of fine parallel grooves running transversely with short intercommunicating branches, and is called the innominate groove pattern. The lamina propria contains lymphoid follicles

2. **Submucosa-** adipose tissue with neural elements (Meissner plexus), blood vessels and lymphatics.

3. **Muscularis propria-** has two layers, an inner circular and an outer longitudinal with the myenteric (Auerbach's) nerve plexus in between. The outer layer is thin, except where it is condensed into three narrow bands called the taeniae coli that contain more collagen and elastic tissue than muscle.

4. **SEROSA**-The intraperitoneal colon is covered by mesenteric serosa. Subserosal fat in the caecum and sigmoid accumulates in small peritoneal pouches to form the epiploic appendages. The

retroperitoneal colon has an adventitial layer, separating muscle from peritoneal fat.

PHYSIOLOGY

The main function of the colon is absorption of water, Na+, and other minerals. By removal of about 90% of the fluid, it converts the 1000-2000 mL of isotonic chyme that enters it each day from the ileum to about 200-250 mL of semisolid feces. The movements of the colon include segmentation contractions and peristaltic waves like those occurring in the small intestine. Segmentation contractions mix the contents of the colon and, by exposing more of the contents to the mucosa, facilitate absorption. Peristaltic waves propel the contents toward the rectum. A third type of contraction that occurs only in the colon is the mass action contraction**,** in which there is simultaneous contraction of the smooth muscle over large confluent areas. These contractions move material from one portion of the colon to another.

PATHOPHYSIOLOGY OF COLONIC POLYPOSIS

The overwhelming majority of intestinal polyps occur on a sporadic basis, particularly in the colon, and increase in frequency with age.

Nonneoplastic polyps-the hyperplasic polyp,the hamartomatous polyp, the inflammatory polyp, and the lymphoid polyp.

Hyperplastic polyps -represent 90% of all epithelial polyps in the large intestine. They may arise at any age but usually are discovered incidentally in the sixth and seventh decades. It is believed that the hyperplastic polyp results from decreased epithelial cell turnover and accumulation of mature cells on the surface. **Harmatomatous polyps** – are malformations of the glands and the stroma. They can occur sporadically or occur in the setting of genetic syndromes. Juvenile polyps represent focal hamartomatous malformations of the mucosal epithelium and lamina propria. Peutz-Jeghers polyps are hamartomatous polyps that involve the mucosal epithelium, lamina propria, and muscularis mucosa.

Inflammatory polyps- also known as pseudopolyps, represent islands of inflamed regenerating mucosa surrounded by ulceration. These are seen primarily in patients with severe, active IBD.

Lymphoid polyps -are an essentially normal variant of the mucosal bumps containing intramucosal lymphoid tissue..

DIAGNOSIS OF COLONIC POLYPOSIS

Diagnosis of colonic polyposis can be done by the following tests.

Methods of colon investigation

Currently, there are four methods for the investigation of the entire colon.

These are

- Double contrast Barium enema
- Conventional colonoscopy.
- CT colonography
- MR colonography

Distal colon(recto-sigmoid) examined by

- Flexible sigmoidoscopy

Flexible sigmoidoscopy

Flexible sigmoidoscopy markedly reduces the mortality [4]. However, one serious disadvantage is the inability to inspect the proximal sections of the colon. Lieberman was able to show that 50-60% of all patients with advanced proximal adenomas exhibit no distal polyps[5]

Double contrast Barium enema

Fischer described the DCBE technique in 1923. It was refined in the **[6]**late 1960s and became the radiologic technique of choice for colon imaging in the mid-1970s. Recently, the DCBE technique was reviewed. It was concluded that performing a high-quality DCBE study requires tailoring of the examination to the clinical history, patient, and fluoroscopic findings. Each colonic segment should be viewed in detail with spot radiographs or magnified digital images. The order in which these are obtained is flexible, as long as each loop of colon has adequate barium coating and distension and is demonstrated en face. Overhead views such as left and right side–down decubitus views and a prone-angled view of the recto-sigmoid junction is helpful in piecing together the spot images.

Conventional colonoscopy

Colonoscopy was first described in 1965by three independent Japanese groups. Since then, technical developments made scopes smaller, easier to manipulate around angles, and improved the quality of the visualization methods and there is possibility of biopsy, polypectomy, or treatment during the examination. Its gold standard.

Compared to DCBE studies and colonoscopy, CT and MR colonography (MRC) have a short history and are still being developed.

CT colonography

CT colonography was described in 1994 by Vining. Computed tomography (CT) colonography(virtual colonoscopy) is a promising new method for detecting colorectal polyps and cancers. Regarding its clinical role, there is no doubt that this imaging techniqueis best suited and highly recommended for those patients who are unable or unwilling to undergo conventional colonoscopy.

Its role as a general screening tool for colon cancer is obvious for many, equivocal for some, and doubtful for others. CT colonography uses multidetector row CT to generate data, which is then converted by computer software into 2-dimensional (2D) and 3-dimensional (3D) displays of the colon. CT colonography has several advantages over conventional colonoscopy: No sedation is needed, it is only minimally invasive, and the examination is less time-consuming than conventional colonoscopy. However, there is still a need for bowel cleansing and insufflations of gas to expand the colon. Moreover, exposure to radiation is inherent to CT, and there is no possibility of biopsy, polypectomy, or treatment during the examination.

MR colonography

MR colonography was described in 1997 by Luboldt et al.

Currently two techniques are being evaluated for MR colonography. Based on the signal within the colonic lumen, they can be differentiated as “bright lumen” and “dark lumen” MRC

i) Bright lumen MRC

With “bright lumen” MRC colorectal lesions are visualized as dark filling defects within the bright colonic lumen. This can be achieved by administering a rectal enema containing paramagnetic contrast . On 3D gradient echo data sets only the contrast-containing colonic lumen is bright whereas the surrounding tissues including colonic wall and polyps remain low in signal intensity. A new approach for “bright lumen” MRC is based on the acquisition of TrueFISP sequences. Using a rectal water-enema, the contrast mechanism is comparable to that of the approach in conjunction with a paramagnetic contrast enema and the acquisition of T1w GRE sequences**.** Since the TrueFISP technique neither requires the administration of intravenous nor rectal paramagnetic contrast medium, it appears economically attractive.

The detection of colorectal lesions with “bright lumen” MRC relies on the visualisation of filling defects. Differential considerations for such a filling defect beyond polyps include air bubbles as well as residual

faecal material. To permit differentiation datasets are collected in both the prone and supine patient position: air and faecal material move, while polyps remain stationary. While effective in most instances, the technique can introduce errors. Thus, polyps with along stalk may move sufficiently to impress as a moving air bubble or more probably residual stool, while stool adherent to the colonic wall may not move at all and, thus, falsely impress as a polyp.

ii) Dark lumen MRC

In addition to obviating the need for the second, time consuming 3D data acquisition “dark lumen” MRC facilitates the identification of polyps.“Dark lumen” MRC focuses on the colonic wall. It is based on the contrast generated between a brightly enhancing colonic wall and a homogeneously dark colonic lumen.[7]

The technique differs from “bright lumen” MRC in the following manner:

1. Instead of gadolinium containing enema only tap water is rectally applied rendering low signal on heavily T1weighted 3D GRE acquisitions.

2. The colonic filling process is monitored with a fluoroscopic T2w sequence, rather than a T1w sequence.

3. To obtain a bright colonic wall paramagnetic contrast is applied intravenously.3D datasets are collected before the application and after a 75 second delay.

4. As residual air exhibits no signal in the colonic lumen, the examination needs to be performed only in the prone patient position. Furthermore, the “dark lumen” technique copes with the problem of residual stool in a simple manner: if the lesion enhances, it is a polyp; if it does not enhance, it represents stool. While most mass lesions smaller than 5 mm in size were missed, almost all lesions exceeding 8mm were correctly identified. MRC identified additional polyps in regions of the colon not reached by colonoscopy.

FECAL OCCULT BLOOD TEST

There are two types of tests, called the guaiac test and the immunochemical test. The fecal immunochemical test is the better test. Either test is done annually. If either test is positive, colonoscopy should be done.

FECAL DNA TESTING.

Colorectal cancers contain abnormal DNA which is shed into the stool. In this a sample of stool is checked for abnormal DNA and colonoscopy is performed if any is found. This test should be repeated at 5 years if it’s negative.

MANAGEMENT OF COLONIC POLYPOSIS

The treatment options available in the management of colonic polyposis are

1) Polypectomy
2) Hemicoloectomy
3) Total coloectomy
4) Follow up

1. INITIAL MANAGEMENT

A. Most patients with polyps detected by barium enema or flexible sigmoidoscopy should undergo colonoscopy to excise the polyp and search for additional neoplasms.

B. The decision whether to perform colonoscopy for patients with polyps less than 0.5 cm in diameter must be individualized depending on the patient's age, comorbidity, and past history of colonic neoplasia.

C. Small polyps encountered during colonoscopy are usually examined by biopsy and then destroyed by fulguration. Representative biopsies are obtained when these small lesions are numerous.

D. When a small polyp is encountered during screening flexible sigmoidoscopy, it should be examined by biopsy to determine if it is an adenoma and thus may be an indication for colonoscopy. The balance of current evidence supports the recommendation that a hyperplastic polyp found during flexible sigmoidoscopy is not, by itself, an indication for subsequent colonoscopy.

E. A patient who has had successful colonoscopic excision of a large sessile polyp (>2 cm) should undergo follow-up colonoscopy in 3 to 6 months to determine if resection was complete. If residual polyp is present, it should be removed and the completeness of resection documented within another 3to 6month interval. If complete resection is not possible after 2 to 3 examinations, the patient should usually be referred for surgical therapy.

2. THE MALIGNANT POLYP

A. No further treatment is indicated after colonoscopic resection of a malignant polyp if the following criteria are fulfilled:

1. The polyp is considered completely excised by the endoscopist and is submitted in toto for pathologic examination.

2. In the pathology laboratory, the polyp is fixed and sectioned so that it is possible to accurately determine the depth of invasion,

grade of differentiation, and the completeness of excision of the carcinoma.

3. The cancer is not poorly differentiated.

4. There is no vascular or lymphatic involvement.

5. The margin of excision is not involved.

B. Patients with malignant polyps with favourable prognostic criteria should have follow-up colonoscopy in 3 months to check for residual abnormal tissue at the polypectomy site, especially if the polyp was sessile. After one negative result of follow-up examination, the clinician can revert to standard surveillance as is performed for patients with benign adenomas.

C. When a patient's malignant polyp has poor prognostic features, the relative risks of surgical resection should be weighed against the risk for death from metastatic cancer. The patient at high risk for morbidity and mortality from surgery should probably not have surgical resection. If a malignant polyp is located in that part of the low rectum that would require an abdominal-perineal resection, local excision rather than a standard cancer resection is usually justified.

3. POSTPOLYPECTOMY SURVEILLANCE

A. Complete colonoscopy should be performed at the time of polypectomy to detect and resect all synchronous adenomas. Additional clearing examinations may be required after resection of a large sessile adenoma or of multiple adenomas to ensure complete resection.

B. Repeated colonoscopy to check for missed synchronous and for metachronous adenomas is performed in 3 years for most patients with a single, or only a few adenomas, provided they have had a high-quality initial clearing examination.

C. Selected patients with multiple adenomas or those who have had a suboptimal clearing examination might require colonoscopy at 1 and 4 years.

D. After one negative 3-year follow-up examination, subsequent surveillance intervals may be increased to 5 years.

E. The presence of severe or high-grade dysplasia in a resected polyp does not, per se, modify recommendations A through D.

F. If complete colonoscopy is not feasible, CT/MR colonography or flexible sigmoidoscopy followed by a double-contrast barium enema is an acceptable alternative.

G. Because patients undergoing resection of a single, small, tubular adenoma (<1 cm) may not have an increased subsequent risk for cancer, follow-up surveillance may not be indicated according to decision analysis of available data.

H. Follow-up surveillance should be individualized according to the age and comorbidity of the patient. Surveillance should be discontinued when it appears unlikely that continued follow-up is capable of prolonging life expectancy.

Mortality/Morbidity

If adenomatous polyps are not removed and progress to cancer, the patient's prognosis depends on the extent of disease, which is reflected in the following disease characteristics:

- Limited to the mucosa
- Entering the muscularis layer lining the colon
- Penetrating through the muscularis layer
- Spreading to nearby lymph nodes
- Reaching distant lymph nodes and/or organs (liver, lung, and/or bone).

Five-year survival rates are predicted by using the Duke classification, as follows:

Duke A	-	The disease is limited to the mucosa.
Duke B1	-	The disease has penetrated into the muscular layer (the muscularis propria), but there is no lymph node involvement.
Duke B2	-	The disease has penetrated through the muscularis propria, but there is no lymph node involvement
Duke C1	-	The disease has penetrated into the muscularis propria, and there is lymph node involvement.
Duke C2	-	The disease has penetrated through the muscularis propria, and there is lymph node involvement.
Duke D	-	The disease has spread to other organs (eg, liver, lung, and/or bone).

Other poor prognostic indicators are deoxyribonucleic acid (DNA) aneuploidy, an undifferentiated cell type, a *1p53* mutation, a pre-operative carcinoembryonic antigen level of greater than 5 ng/mL, venous invasion, penetration of the bowel wall, perforation of the colon, and adherence to adjacent organs.

REVIEW OF LITERATURE

MR colonography was described in 1997 by Luboldt et al.

After in 1997 Royster AP, Fenlon HM, Clarke PD, et al. used new technique of 3D virtual colonoscopy and compared with conventional colonoscopy. they concluded that MR virtual colonoscopy used for complete colonic examination and rectify some of 2D MR colonography drawback.[8].

Vining and colleagues in 1998 repeated virtual colonoscopy and compared with colonoscopy the results were promising and concluded as alternative to optical endoscopy, and virtual colonoscopy useful for complete examination of colon[9] During 1999 Lubolt et al& Ajaj.w et al discussed about the need of colonic distension .Most colonic loops are collapsed in their physiologic state, the large bowel needs to be distended to allow a reliable assessment of the bowel wall. Otherwise, non distended colonic segments may mimic bowel wall thickening and lead to a misinterpretation of inflammation or even colorectal malignancy. Furthermore, smaller lesions, such as colorectal polyps, may be missed. To assure sufficient distension, the rectal administration of water, water-based fluids, air, or carbon dioxide has been proposed [10,11].

In 2000, A trial by Luboldt W, Bauerfeind P, Wildermuth S, et al. Colonic masses: detection with MR colonography -demonstrated that diagnostic accuracy of MRC was highly dependent on polyp size: although most polyps smaller than 5 mm were not detected by MRC, the sensitivity for the detection of polyps larger than 10 mm was greater than 90%.[12].

Lauenstein TC, Goehde SC, Ruehm SG, et al. introduced faecal tagging method in 2002.MRcolonography with barium-based faecal tagging- initial experience was favourable to differentiate polyp from faecal material in faecal tagging patients. faecal tagging avoid the need of tedious colonic preparation[13]

During 2003-Ajaj W, Pelster G, Treichel U, et al. compared Dark lumen magnetic resonance colonography with conventional colonoscopy for the detection of colorectal pathology. Dark lumen MRC was as sensitive and specificity as colonoscopy in polyp deduction. Using gadolinium contrast polyp seen brightly and extraluminal pathology were well made out. [14]

Lauenstein TC, Ajaj W, Kuehle CA, et al.were compared two different Magnetic resonance colonography techniques in 2005. comparison of contrast-enhanced three-dimensional vibe with two-dimensional FISP sequences.preliminary experience shows 3D vibe is

superior in demonstrate polyp than FISP.3D virtual colonoscopy and complete colonic examination is possible with 3D vibe sequence[15]

Late in 2005-Ajaj W, Lauenstein TC, Pelster G, et al. demonstrate the advantages of MR colonography in patients with incomplete conventional colonoscopy.MRC is useful to examine patients with distal colonic stenosis[16]

During 2005-Schreyer AG, Rath HC, Kikinis R, et al. Comparison of magnetic resonance imaging colonography with conventional colonoscopy for the assessment of other intestinal lesion like intestinal inflammation in patients with inflammatory bowel disease. The results were inconclusive. [17]

After in2005-Hartmann D, Bassler B, Schilling D, et al. used MR colonography in patients Incomplete conventional colonoscopy and in the evaluation of the proximal colon.MRC is superior to colonoscopy in detection of proximal colon lesion in case of distal stenosis/obstruction.[18]

2006 -Rottgen R, Herzog H, Bogen P, et al. MR colonoscopy at 3.0 T: comparison with 1.5 T in vivo and a colon model[19]. 3T MRC gives high resolution and useful for 5mm polyp.

2006-Hartmann D, Bassler B, Schilling D, et al. Colorectal polyps: detection with dark-lumen MRcolonography versus conventional

colonoscopy.Extraluminal pathology well demonstrated by dark lumen MRC which is not possible by colonoscopy[20]

In 2007-Kinner S, Kuehle CA, Langhorst J, et al.were compared MR colonography versus optical colonoscopy on the basis of patient acceptance, the results concluded that of MRColonography is equally acceptable to colonoscopy in screening population[21]

2007-Kuehle CA, Langhorst J, Ladd SC, et al. MR colonography without bowel cleansing—a prospective cross-sectional study in which concluded that fecal tagging is highly acceptable by screening population.[22]

MATERIALS AND METHODS

Study Design

The study was conducted in Barnard institute of radiology.The study was monocentric in design, with 35patients for whom a colonoscopy had been indicated such as bleeding per rectum, family history of colonic polyps. Magnetic resonance imaging and conventional colonoscopy are performed in all patients within one day, after appropriate intestinal cleansing. The primary objective of the study was to run a prospective comparison between MR colonography and conventional colonoscopy in the detection of colorectal polyps. The goal here was to determine whether MR colonography bright lumen technology available today, reaches the gold standard of conventional colonoscopy in the diagnosis of colorectal polyps. Other study objectives were to compare both methods in terms of patient acceptance and satisfaction. Before the planned colonoscopy, the patient undergoes an MR colonography after written informed consent. The two examinations are performed and diagnostically evaluated independently of each other by experienced radiologists and gastroenterologists.

Inclusion Criteria

- Patients over 10years
- Colonoscopy indicated

- Good health
- Written declaration of consent from patient

Exclusion Criteria

- Patients under 10years
- Known patient with anal incontinence
- Known MR contraindications, e. g., pacemakers, intra corporeal metal parts, claustrophobia, hip prostheses

ASSESSMENT

Detailed history is taken regarding type and duration of symptoms, family history, and previous intestinal surgery. Following this, cases were assessed clinically. After a brief clinical evaluation of patients every patient was subjected to a colonic preparation

BOWEL PREPARATION

Bowel purgation and cleansing process should be started the evening before the MR colonography scan**.** Bowel clean with wet method using peglec (electrolyte containing polyethylene glycol) purgative.

Peglec net weight:137.9 gms mix with 2L of plain water gives

Polyethylene glycol- 18meq/L

Sodium -125meq/L

Potassium-10meq/L

Chloride-35meq/L

Sulphate-80meq/L

Bicarbonate-20meq/L

200ml of peglec solution per orally in every 15minutes for five times was given. Usually first bowel movement should occur one hour after administration of peglec preparation, and then evacuation occurs several times, keep administering peglec until the rectal effluent is clear. Lavage is usually complete after the intake of 1.5-2L.

PATIENT PREPARATION

After a complete intestinal cleansing the day before and an overnight fasting period, the patient preparation is initially performed on the day of the examination using the latest generation of 1.5 Tesla full body MRI (MAGNETOM Sonata, Siemens Medical S). Before the patient put into MRI bore, must be screened for general contraindications to MR imaging including the presence of metallic implants or severe

claustrophobia, Hip prostheses. A thin intestinal tube is inserted after rectal palpation. After having assumed a supine position, the patient is conveyed into the diagnostic system, 20mg (2ml) of inj. scopolamine antiperistaysis medicine is then intravenously administered to help obviate bowel spasms, minimize artefacts caused by bowel motion, and provide greater bowel distension and then intestine is filled with 1.5-2 litres of lukewarm water through the indwelling rectal probe. This enables a good contrasting of the intestinal lumen. Complete filling of the large intestine and distension are monitored via real-time acquisition of fast gradient echo images by means of a TrueFISP (Fast Imaging with Steady State Precession) sequence ,The filling procedure should be stopped if the patient complains about discomfort such as abdominal cramps or pain or sufficient colonic distension upto the caecum has been achieved with intra luminal water . For signal reception, a combination of two flex surface coils should be used to assure the coverage of the entire abdomen and pelvis. High contrast between the bowel wall and bowel lumen is crucial for reliable visualization of pathology arising from the colonic wall. The contrast mechanisms depend on the MR sequences as well as on the composition of the rectal enema. In bright lumen MRC bowel wall appears dark, and Bright-lumen MRC images can be obtained by acquiring T2-weighted images in conjunction with a transverse and coronal TrueFISP sequences in breath-hold.

SCAN TECHNIQUE

After obtaining a localizer sequence, the acquisition of 3D fast imaging with True steady-state precession sequences (TrueFISP), A 3D TrueFISP dataset of the abdomen encompassing the entire colon is collected in coronal and axial sections of both prone and supine position with following parameters

- TR:4.45ms,
- TE:2.23ms,
- Flip angle 70°,
- Field of view (FOV) 400 x 400mm,
- voxel size of about 1 mm x 1 mm x 1.6 mm.
- slice thickness 3mm,
- Acquisition time 21sec.

In addition to MRC all patients underwent conventional colonoscopy on the same day of the MR examination. To compensate for the presence of residual air exhibiting filling defects similar to polyps within the colonic lumen, 3D datasets are collected in both the prone and supine patient positions. Here-after the enema bag is placed on the floor for facilitated emptying of the colon and the patient is removed from the

scanner. On the 3D GRE datasets only the colonic lumen containing the enema is bright, whereas all other tissues remain low in signal intensity. The resulting contrast between the colonic lumen and surrounding structures is the basis for the subsequent virtual colonographic viewing. Bright lumen MRC can be completed within 20 minutes, including the time for patient positioning, image planning, and data acquisition. The 3D datasets are subsequently processed using commercially available software and hardware. A complete analysis of an MRC examination still requires 15 minutes of interactive image viewing on a high performance work station. In the first step MRC images should be interpreted in the multi-planar reformation mode scrolling through the prone 3D dataset in all three orthogonal planes. In regions containing larger pockets of residual air, the assessment needs to be supplemented by views of the supine dataset. In the second step the data should be assessed based on virtual endoscopic renderings displaying the inside of the colonic lumen. A virtual endoscopic fly through allows the observer to concentrate on the colon facilitating the depiction of small structures protruding into the colonic lumen. Furthermore, the three dimensional depth perception permits the assessment of haustral fold morphology, thereby increasing the ability to distinguish polyps from haustra. To assure the complete visualisation of both sides of haustral folds, the virtual flythrough should be performed in an antegrade as well as retrograde direction. One of the main advantages of this type of sequence is its relative insensitivity to motion, which might be especially helpful in patients unable to hold their

breath. These data should be collected without fat suppression, because the technique allows good visualization of the colon itself and also of mesenteric structures (mesenteric lymph nodes). Image features are characterized by a mixture of both T1 and T2 contrast, creating a homogenous bright signal of the colonic lumen filled with water.

LIMITATIONS

Bowel preparation could not be avoided. Small size polyps <8mm were less sensitive to detect. Fecal material may mislead for polyps. Not able to biopsy. No possibility of intervention

MR COLONOGRAPHY

Abnormal Finding

Bright lumen technique bowel wall appears dark. Fluid filled lumen appears bright. Polyps appears as dark filling defect within fluid filled bright colonic lumen. Extension of lesion along the length of lumen and extraluminal extension appears dark and loss of fat plane gives clue to diagnosis. Other abdominal organs can be evaluated at same time.

CONVENTIONAL COLONOSCOPY

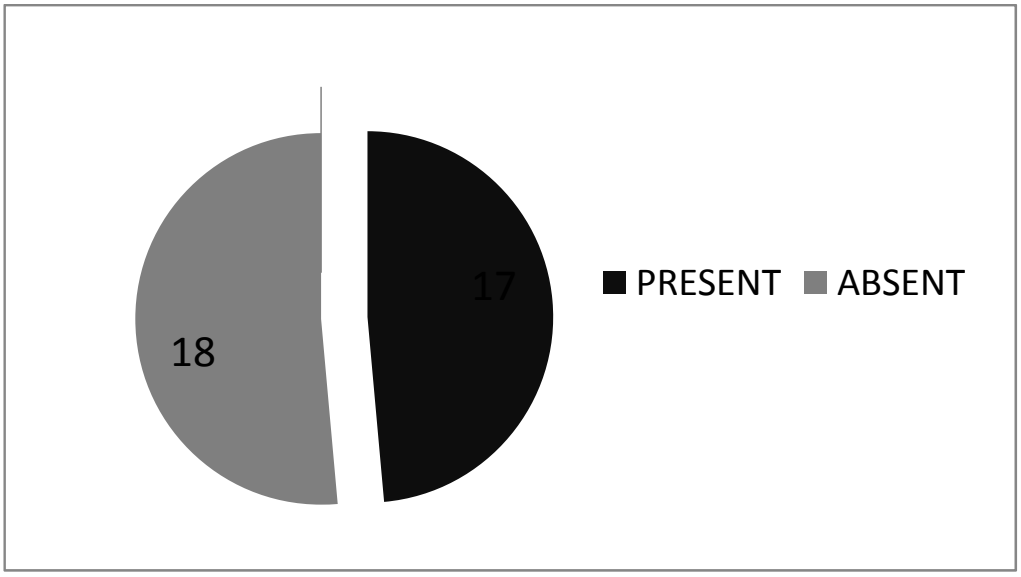
Direct visualization of polyp as mucosal projection and also biopsy can be taken.

RESULTS AND OBSERVATIONS

ANALYSIS BASED ON TYPE OF POLYPOSIS

Table-1

Type of polyposis	No. of cases	%
Family history present	18	51.44
Family history absent	17	48.6



ANALYSIS BASED ON AGE GROUP

Family History-present

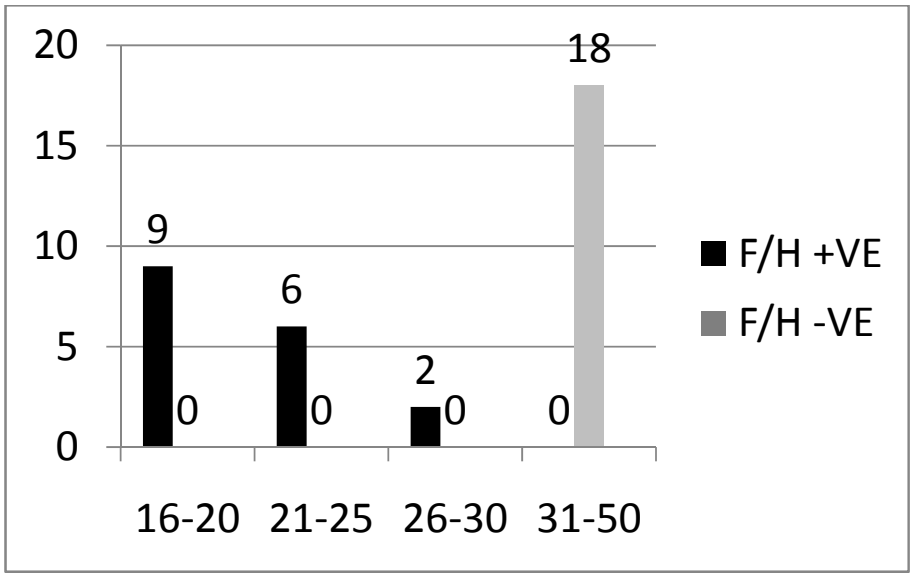
Table. 2

Age	No. of cases	%
16 – 20	9	52.9
21 – 25	6	35.2
26 – 30	2	11.7
31-45	NIL	NIL

Family History-absent

Table. 3

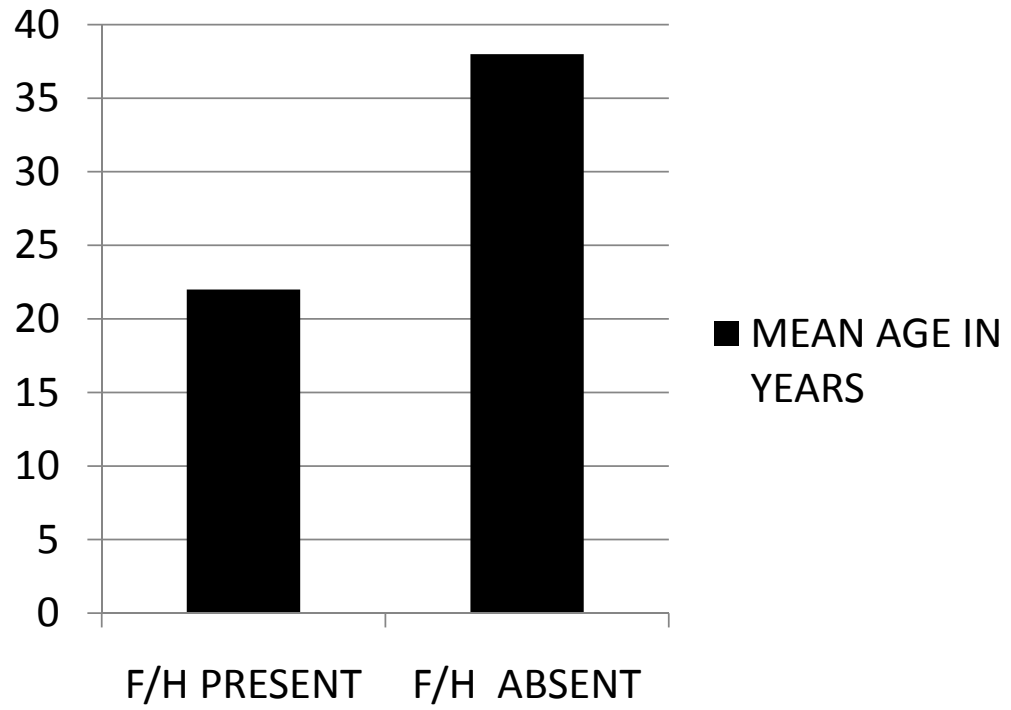
Age	No. of cases	%
16 – 30	Nil	Nil
31 – 35	9	50
36 – 40	6	33.3
41 – 45	3	16.6



MEAN AGE

Table-4

Family history	**Mean age** **years**
present	22
Absent	38



SITE OF COLON PREDOMINANTLY INVOLVED

Family History present

Table-5a

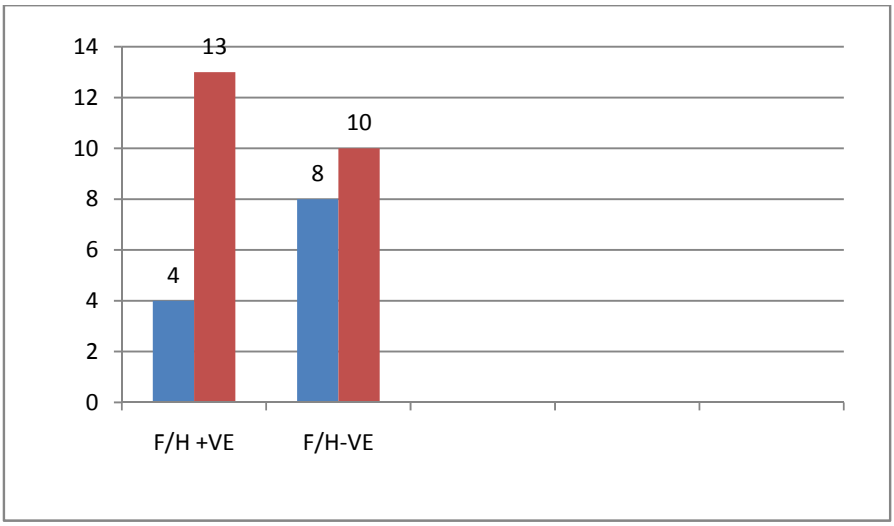
Site	Family History present
Right colon	4
Left colon	13

Family History Absent

Table-5b

Site	Family Histroy Absent
Right colon	8
Left colon	10

SITE OF COLON PREDOMINANTLY INVOLVED



PREVIOUS COLONIC INTERVENTION

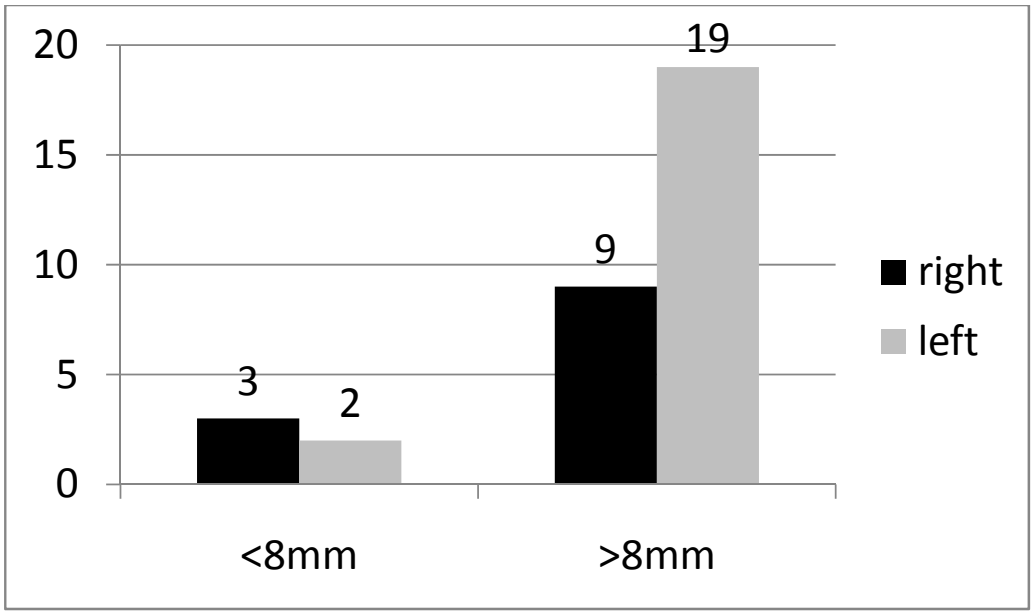
Table-6

Family History present	2
Family History absent	1

COLONIC POLYPS– DIAGNOSIS BY MR COLONOGRAPHY

Table-7

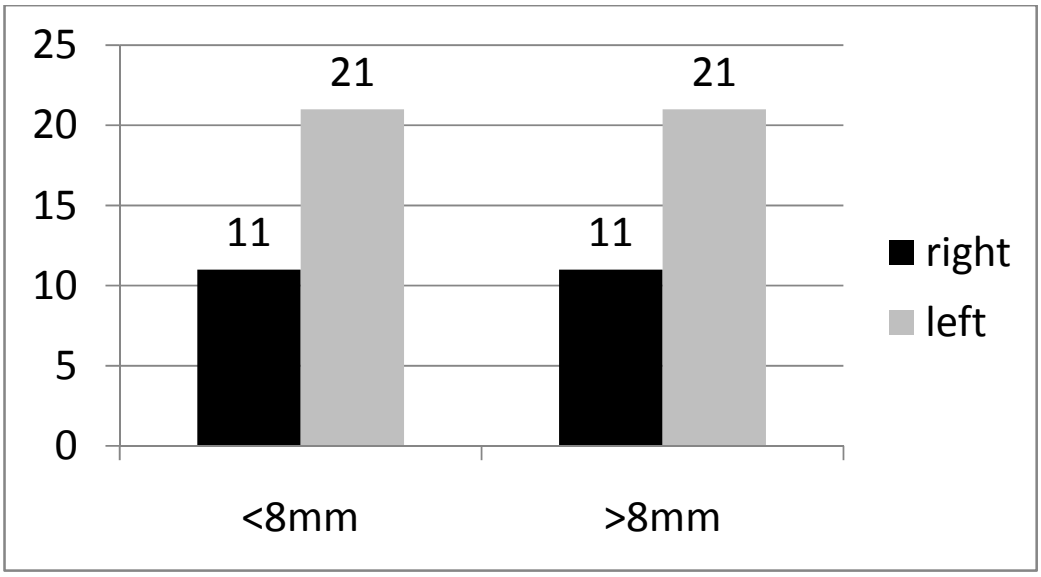
Results	No. of polyps	
	Right	Left
<8mm	3	2
>8mm	9	19



COLONIC POLYPS– Diagnosis by Conventional Colonoscopy

Table-8

Results	**No. of polyps**	
	Right	**Left**
<8mm	11	21
>8mm	11	21

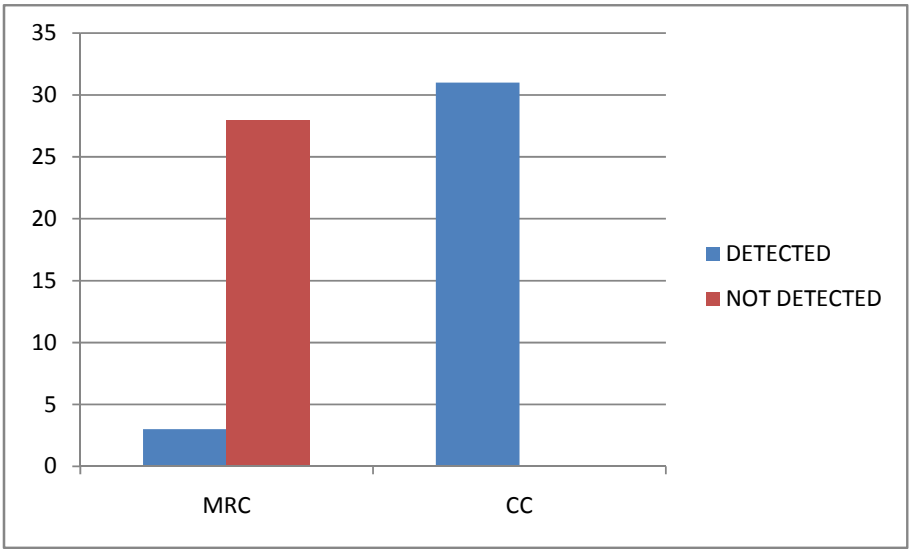


COMPARISON OF MRC &CC

Lessthan 8mm Polyp

Table-9

Procedure/ <8mm polyp	DETECTED	NOT DETECTED
MRC	3	28
CC	31	-

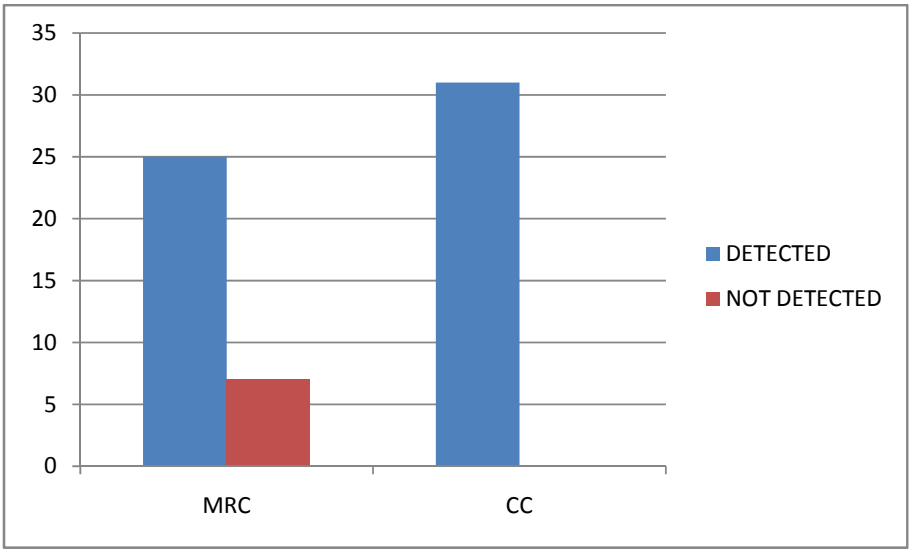


COMPARISON OF MRC &CC

Morethan 8mm Polyp

Table - 10

Procedure/ >8mm polyp	DETECTED	NOT DETECTED
MRC	25	7
CC	32	-



STATISTICAL TABLE

Table-11

CC / MRC	**Polyp deducted >8mm**	**Polyp not deducted >8mm**	**Total**
Polyp deducted >8mm	25 TP	3 FP	28
Polyp not deducted >8mm	7 FN	13 TN	20
Total	32	16	48

TP – true positive TN – true negative

FP – false positive FN – false negative

Bright lumen MR colonography

Sensitivity is found to be 78.12 % while specificity is 81.25%.

Accuracy is 79.16% while positive predictive value is 89.28 % and negative predictive value is 65 %.

ASSOCIATED PATHOLOGY

Table-12

Pathology	MRC	CC
Liver cyst	1	Nil
Ovarian cyst	1	Nil
Uterine fibroid	1	Nil
Cholelithiasis	1	Nil

The associated pathology was more easily demonstrable with MRC according to my study.

DISCUSSION

A study involving 50 patients with personal and family history of colonic symptoms to investigated MRcolonography versus conventional colonoscopy as standard. Two patients were excluded due to technical reasons.48 patients were underwent MRcolonography. Out of 48 cases 13 were negative for polyp in both MRC and CC. Thirty five cases taken for discussion.

Out of 35 cases 17 cases were family history positive. Male patients were 19. Left side colon involved in 23 and right side colon 12. Mean age of Familial and Non-familial colonic polyps was 22 and 38 years respectively .On analysis , conventional colonoscopy 32/48cases were found to have polyps and 16/48cases were of not having polyp. MR colonography 28/48 cases were detected as polyp and 7 cases read as negative for polyp.MRC true positive cases are 25 and false positive are 3. Fecal material detected as polyp. Seven cases were not detected by MRC.MR colonography detected polyp >8mm size.

With above data Bright lumen MRcolonography Sensitivity is found to be 78.12 % while specificity is 81.25%.Accuracy is 79.16% while positive predictive value is 89.28 % and negative predictive value is 65 %. Extra luminal pathology cholelithiasis, ovarian cyst, fibroid, renal calculi, liver cyst were detected by MRcolonography which is not

detected by colonoscopy. Conventional colonoscopy is used to biopsy of polyp at the time of examination which is disadvantage of MRC.

COST IMPACT :

No cost effectiveness information was found regarding MR colonography.

ETHICAL, CULTURAL OR RELIGIOUS CONSIDERATIONS:

No issues were identified/ raised in the sources examined.

OTHER ISSUES:

No issues were identified/raised in the sources examined.

This study undertaken in Barnard institute of Radiology included 50 cases of in two cases were not included in analysis due to technical error.

Comparison was made with previous studies conducted in evaluation of MRC and CC

Table-13

Author	Year	Sensitivity Per patients	Specificity Per patients	Positive predictive value	Negative predictive value
Luboldt et al. (23)	2000	60	81	71	61
Pappalardo et al. (24)	2000	96	93	98	88
Saar et al. (25)	2000	100	100	100	100
Lauenstein et al. (26)	2002	92	100	100	89
My study	2008-2009	78.12	81.25	89.28	65

CONCLUSION

MR colonography-bright lumen, when compared to colonoscopy, has moderate sensitivity and specificity. Patient acceptance of MR colonography is at least equal to acceptance of colonoscopy. MR colonography is a new diagnostic procedure that makes it possible to noninvasively visualize the entire large intestine without exposure to radiation.MR colonography-bright lumen method not useful for screening of colonic polyps. However new techniques like darklumen with 3D virtual colonoscopy use may facilitate the acceptance of preventive screening for colorectal polyps without exposing patients to high levels of radiation, as opposed to computerized tomography. The objective would not satisfy be to compete with colonoscopy as the diagnostic gold standard, but rather to offer patients another screening option. Given that only about one fourth of all eligible patients avail themselves of colonoscopy screening, MR colonography might play an important role in the preventive screening concept for colorectal carcinoma alongside the test for occult blood, clinical and digital rectal examinations, and endoscopic procedures if included newer technique. MRC is a vital tool in assessing the colon in case of incomplete colonoscopy and for extraluminal pathology.Better resolution of colon.

Advantages:

- Non-invasive, no direct complications
- Lack of sedation, Less unpleasant, Probably higher compliance,
- Moderate sensitivity, specificity
- Ante-/retrograde visualization possible
- Excellent assessment of morphological changes
- Preoperative cancer staging, Lack of radiation dose
- Continuous monitoring of contrast(saline/water) installation
- Superior extra intestinal pathology assessment

Disadvantages and pitfalls

- Bowel preparation, colonic cleansing
- Artifacts (residual air, respiration)
- Poor resolution compared to colonoscopy
- Poor direct visualization of the mucosa

CONVENTIONAL COLONOSCOPY

Advantages:

- Quick evaluation
- Therapeutic option
- High sensitivity and High specificity
- Well investigated
- Well established
- Direct visualization of the mucosa

Disadvantages

- Complications (perforations, mortality)
- Bowel preparation, colonic cleansing
- More incomplete examinations
- Unpleasant
- Longer examination
- Sedation

- Lower patient compliance
- Only ante-grade visualization
- Only 80–90 % visualization of the mucosa.

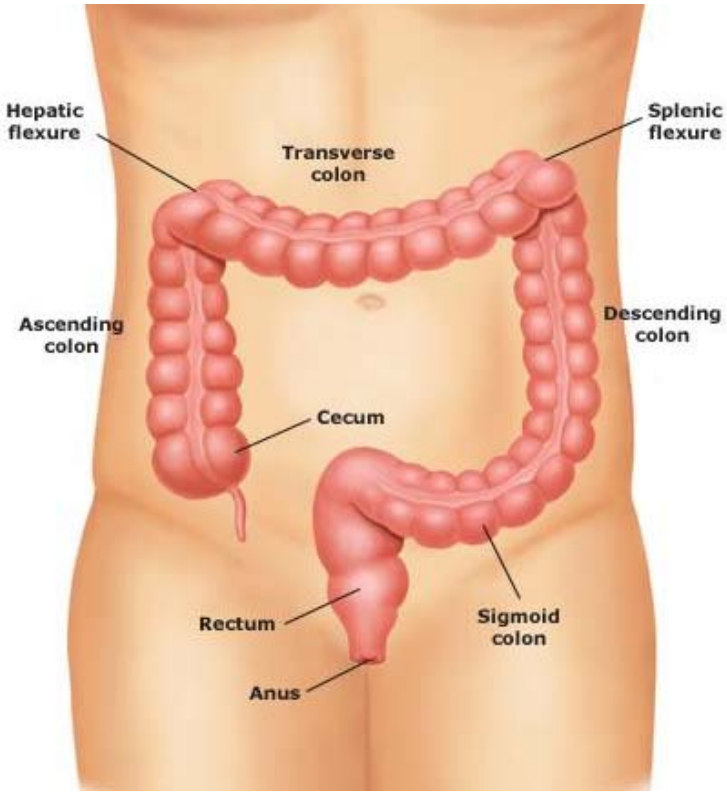
MASTER CHART

S. NO.	AGE	SEX	FAMILY HISTORY	PREDOMINANT DISTRIBUTION	POLYP DETECTION				ASSOCIATED PATHOLOGY
					MRC		CC		
					<8 mm	>8 mm	<8 mm	>8 mm	
1	17	FE	PRESENT	LEFT COLON	N	P	P	P	
2	36	M	ABSENT	LEFT COLON	N	P	P	P	
3	20	FE	PRESENT	LEFT COLON	N	P	P	P	
4	18	M	PRESENT	LEFT COLON	N	P	P	P	Cholelithiasis
5	16	M	PRESENT	RIGHT COLON	N	P	P	P	Lt Ovarian Cyst
6	21	FE	PRESENT	LEFT COLON	N	N	P	P	
7	41	FE	ABSENT	LEFT COLON	N	P	P	P	Fibroid Uterus
8	32	M	ABSENT	LEFT COLON	P	P	P	P	
9	38	FE	ABSENT	RIGHT COLON	N	P	P	P	
10	30	FE	PRESENT	LEFT COLON	N	P	P	P	
11	26	M	PRESENT	LEFT COLON	N	N	P	P	
12	21	M	PRESENT	RIGHT COLON	N	P	N	N	
13	17	M	PRESENT	RIGHT COLON	N	P	P	P	
14	35	M	ABSENT	LEFT COLON	N	P	P	P	
15	31	M	ABSENT	LEFT COLON	P	P	P	P	Diverticulosis
16	39	FE	ABSENT	RIGHT COLON	N	P	P	P	
17	20	M	PRESENT	LEFT COLON	N	N	P	P	
18	23	M	PRESENT	LEFT COLON	N	P	N	N	

S. NO.	AGE	SEX	FAMILY HISTORY	PREDOMINANT DISTRIBUTION	POLYP DETECTION				ASSOCIATED PATHOLOGY
					MRC		CC		
					<8 mm	>8 mm	<8 mm	>8 mm	
19	18	FE	PRESENT	LEFT COLON	N	P	P	P	
20	33	FE	ABSENT	RIGHT COLON	P	P	P	P	
21	23	M	PRESENT	LEFT COLON	N	P	P	P	
22	25	FE	PRESENT	LEFT COLON	N	P	P	P	
23	35	M	ABSENT	LEFT COLON	N	N	P	P	
24	48	M	ABSENT	LEFT COLON	N	P	P	P	Rt renal calculus
25	34	FE	ABSENT	RIGHT COLON	P	P	P	P	
26	19	FE	PRESENT	LEFT COLON	N	P	P	P	
27	21	M	PRESENT	RIGHT COLON	N	N	P	P	
28	37	M	ABSENT	RIGHT COLON	N	P	P	P	
29	31	M	ABSENT	LEFT COLON	N	P	N	N	
30	20	FE	PRESENT	LEFT COLON	N	P	P	P	Liver Cyst
31	32	FE	ABSENT	RIGHT COLON	N	P	P	P	
32	38	FE	ABSENT	LEFT COLON	N	P	P	P	
33	33	M	ABSENT	RIGHT COLON	P	N	P	P	
34	45	M	ABSENT	LEFT COLON	N	P	P	P	
35	40	FE	ABSENT	RIGHT COLON	N	N	P	P	

MRC-MAGNETIC RESONANCE COLONOGRAPHY
CC- CONVENTIONAL COLONOSCOPY M-MALE FE-FEMALE P-POLYP DETECTED
N – POLYP NOT DETECTED

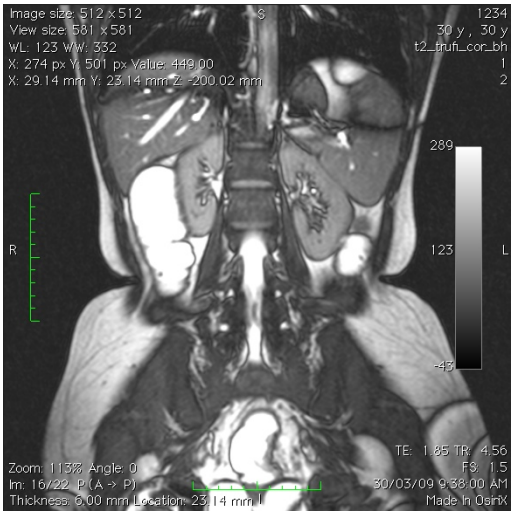
FIG-1


Hepatic flexure
Transverse colon
Splenic flexure
Ascending colon
Descending colon
Cecum
Rectum
Sigmoid colon
Anus

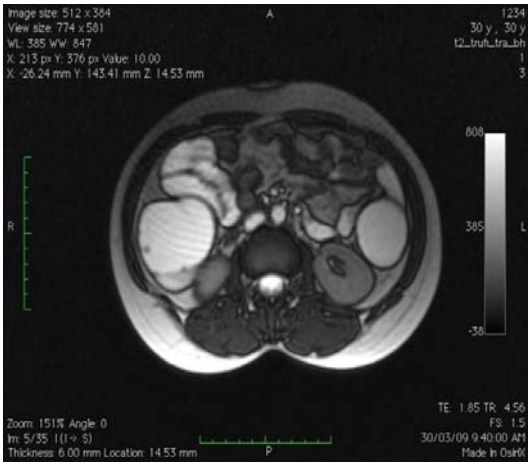
IMAGES

MR COLONOGRAPHY POLYP

CORONAL



AXIAL



CONVENTIONAL COLONOSCOPY-POLYP

POST OPERATIVE SPECIMEN OF COLONIC POLYP

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PROFORMA

MRI COLONOGRAPHY VERSUS CONVENTIONAL COLONOSCOPY IN DETECTION OF COLONIC POLYPOSIS CONVENTIONAL COLONOSCOPY AS GOLD STANDARD

Name: Age: Sex:

Address:

Occupation:

Present history:

Bleeding per rectum- present /absent. If present duration_____.

Past history:

Glaucoma/eye pain, Urinary retention, anal incontinence, Claustrophobia

Family history:

Colonic polyps-suffered/treated/death

If so degree of relation_____.

Surgical history:

Abdominal –

Any metallic implants

Pacemaker/aneurismal clip/coil

MR colonography-Bright lumen technique

Polyps

SITE	PRESENT/ABSENT	SIZE in mm
Caecum		
Ascending colon		
Hepatic flexure		
Transverse colon		
Splenic flexure		
Descending colon		
Sigmoid colon		
Rectum		

Any other colonic lesion:

Extraluminal lesions in abdomen

CONVENTIONAL COLONOSCOPY

Polyp -Present/absent

Site: Size:

Biopsy/ polypectomy.